Method for coating fiber-reinforced plastic structural parts and structural part so produced

The invention relates to a method for refining surfaces of structural parts made of reinforced-reinforced plastics materials according to the preamble of the first claim, and to a structural part so produced.

Structural parts made of reinforced-reinforced plastics materials, wherein the structural part is produced using the resin-transfer-molding (RTM) process, the long-reinforced-reinforced thermoplastic (LFT) process, the glass-mat-reinforced thermoplastic (GMT) process or the sheet-compound-compound (SMC) process, for example, are coated in order to refine and color the surfaces, in particular if they are used as body parts in the manufacturing of motor vehicles. The coating process is, however, very laborious, as the surfaces of the plastics material structural parts must be prepared for the coating process, on account of the production processes, which cause an uneven surface structure. Surface defects on non-refined structural parts may be caused, for example, by voids, craters or protruding fiber ends. A mechanical surface treatment, by means of grinding or smoothing, for example, is generally required, so that the necessary surface quality may only be obtained with a high degree of manual effort. The additional application of surface coatings, for example resinous non-woven coatings or IMC (in-mould coating), also aims to level the surface.

It is known from the specialist paper by Achim Grefenstein, *Folienhinterspritzen statt Lackieren*, in *Metalloberfläche - Beschichten von Kunststoff und Metall*, Vol. 10/99, Carl Hanser Verlag, Munich, to use films for refining surfaces in injection-molding technology. The films are inserted, preformed, into an injection mould. The cavity of the film is then insert-

molded, in a known manner, with plastics material, in order to produce the refined surface in a single operating step. However, only relatively small plastics material structural parts, up to specific dimensions, may be produced using the film insert molding technique. Larger structural parts, such as the front or tail gates of passenger vehicles or the wind deflectors of industrial vehicles, for example, which, as a result of their fiber reinforcement, also display the required mechanical properties, may be produced using the pressing processes or the RTM process, for example. However, the surface quality required for coating cannot be achieved using these processes either.

The object of the invention is to reduce the effort involved in refining the surfaces of structural parts made of reinforced-reinforced plastics materials.

The object is achieved in that a plastics material film that already displays the desired properties with regard to the structure and optionally the color of the surface of the structural part and that is preformed in accordance with the topography of the surface of the structural part is inserted into a mould corresponding to the dimensions of the structural part, in that, in a process that is adapted to the composition of the semi-finished product, a reinforced-reinforced plastics material, preferably comprising a thermoset or thermoplastic matrix, is applied to the side of the preformed film that is not the surface, and in that, after the reinforced-reinforced plastics material has hardened or cooled, the finished structural part is removed from the mould.

The surface of the structural part may be refined by means of film insert molding or film resin-transfer-molding (film RTM). In the case of film insert molding, the preformed film is placed on one of the molding tools

of a press, into the female mould or onto the male mould, the reinforced-reinforced plastics material, in the form of a mat or a polymer melt, is placed on the counterpart of the tool of the press, and, in a pressing process that is adapted to the composition of this semi-finished product, the preformed film is connected to the mat or the polymer melt.

Film resin-transfer-molding takes place in a closed mould, which is comparable to the closed compression moulds, the female moulds and male moulds, of a press. The preformed film is inserted into the mould and a fiber mat, i.e. only the fiber reinforcement, is inserted under the cavity of said mould. In a known manner, the mould, once evacuated, is filled with a mixture of resin and hardener, the mat being saturated and the cavity under the film being filled. The mould remains closed until the injected resin has hardened. This technique is also conceivable in the open process.

The method according to the invention allows large structural parts with large surfaces, such as boot lids or door elements, for example, to be produced cost-effectively both by film insert pressing and by film resin-transfer-molding, and with a surface quality that is comparable to that obtained with known film insert molding. Reinforced-reinforced plastics materials and treatment processes may now be applied with which, in the past, the surfaces produced could only be refined with the above-described high degree of effort. The films may contain colored layers or specially prepared coating layers. Coextruded, two-coat or three-coat films, as are also used in film insert molding, are particularly suitable. The coextrusion of thin, colored plastics material layers within a two-coat or three-coat composition allows layers to be built up that are similar to coating layers. The method according to the invention allows reinforced-reinforced plastics

materials, preferably comprising a thermoset or thermoplastic matrix, to be refined without preparing the surface and without coating, in a substantially smaller number of operating steps than in the conventional method. A subsequent coating procedure, with reduced effort, is possible for effect colors.

The course of the film insert pressing process is illustrated in greater detail in a flow diagram, with reference to the process steps shown schematically in Figs. 1 to 6. In the process step according to Fig. 1, a film 1 that is suitable for the film insert pressing process is removed from a roller 2 and cut to the required size. In the process step according to Fig. 2, this film 1 is placed on a mould 3 that displays the topography of the surface of the structural part to be produced, and, during the film preforming, is deformed by means of suitable devices, indicated by the reference numeral 4, preferably under thermal influence, in such a way that a film 5 having the topography of the surface of the structural part to be produced is created. After any protruding flashes and material remnants have been removed (in a manner not shown here), the preformed film 5, in the process step according to Fig. 3, is placed into the female mould 6 of a schematically illustrated press 7. The contour of the male mould 8 allows for the wall thickness of the structural part to be produced. In the process step according to Fig. 4, a semi-finished product 9 made of reinforced-reinforced plastics material is inserted into the press 7, below the cavity of the film 5, so that the preformed film 5 is the outer surface or display side, i.e. the side of the structural part that is visible and exposed to the environment. In the process step according to Fig. 5, a molding process that is adapted to the semi-finished product 9 takes place, wherein the reinforced-reinforced plastics material fills the cavity between the male mould and the preformed film 5, and adapts to the

contour thereof. Reinforced-reinforced plastics materials that may be deformed by means of extrusion and thermal processes, in particular SMC, GMT and LFT, are particularly suitable semi-finished products. The temperature required for molding must be below a temperature that might cause damage to the film 5. After the reinforced-reinforced plastics material has hardened or cooled, the press 7, as shown in Fig. 6, is opened and the finished structural part 10 may be removed after it has been lifted from the male mould 8, by means or ejectors 11, for example. After the edges of flashes of the glass reinforced-reinforced plastics material have, if necessary, been cleaned, the structural part may be used. The film 5 provides the structural part 10 with a surface that is ready for use and does not require any finishing or coating. A subsequent coating procedure, with reduced effort, is possible for effect colors.